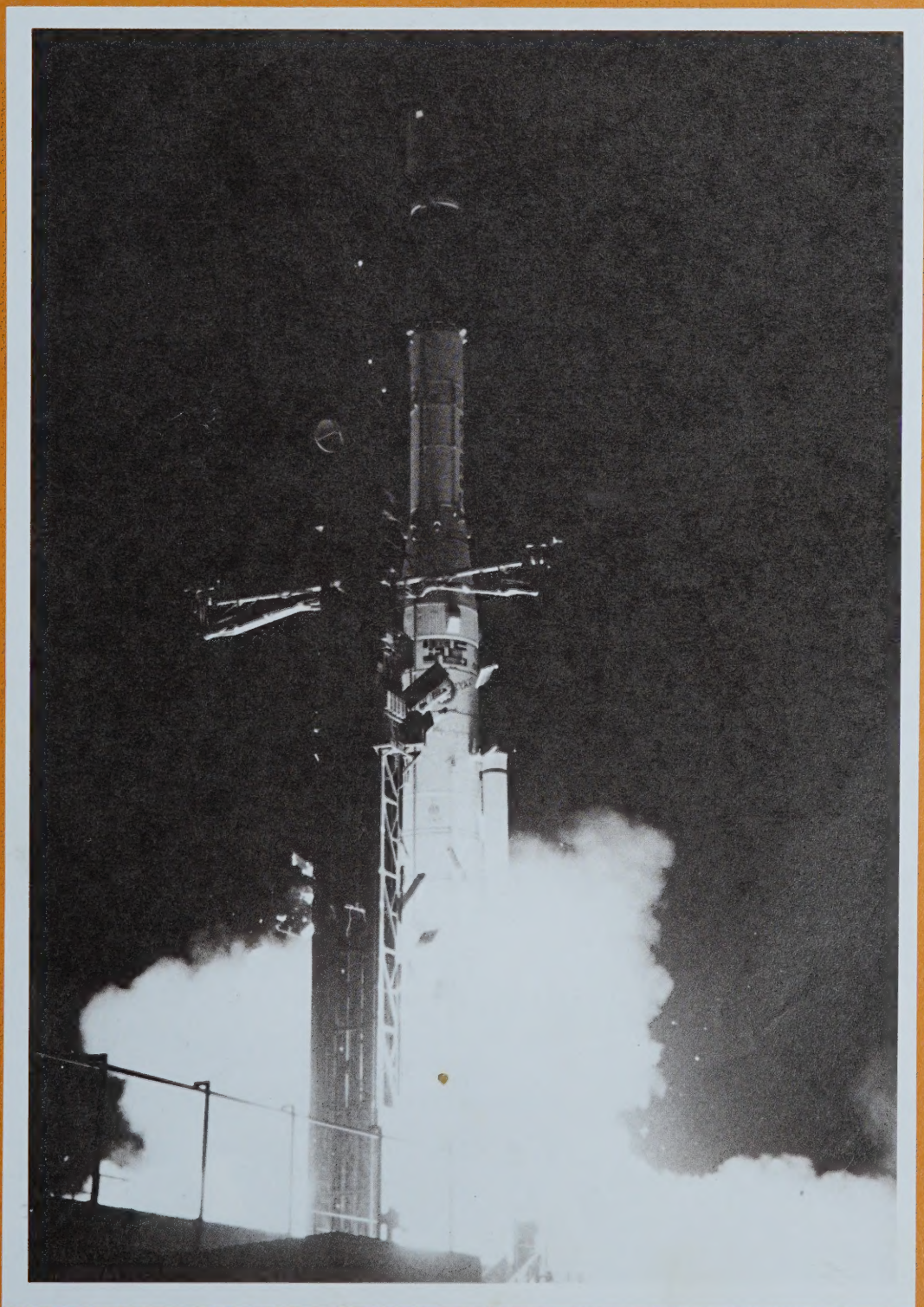
AMSAT

SATELLITE JOURNAL

Journal of the Radio Amateur Space Program

July-August 1985, No. 5



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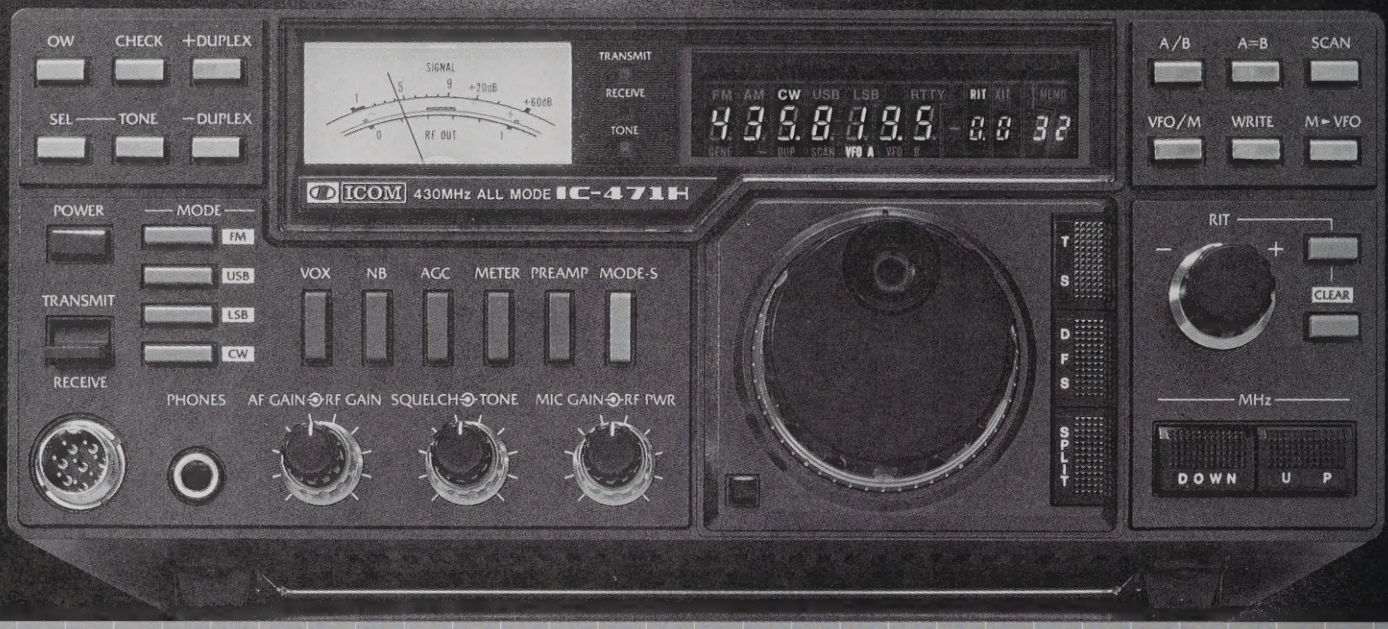

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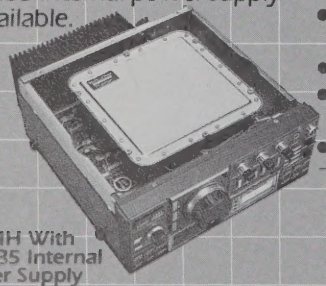

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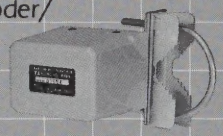

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CONTENTS

On the cover: An Ariane V launcher lifts off its pad at the European Space Agency facility in Kourou, Guyana in early 1985. The night launch carried the Arabsat and Brasilsat satellites.

PERSPECTIVE

No chocolate???!!! That was my reaction when the doctor told my mother that I just might be allergic to that gastronomic delicacy. I just couldn't imagine not eating chocolate, especially ice cream.

It was rough, those first few weeks of withdrawal, but I managed to cope. My allergy, perhaps fortunately, didn't go away so the doctor ruled out chocolate as the cause of my malady. I outgrew the allergy but I retained my taste for chocolate. Maturity has helped me cope with the passion and I have successful kept my weight in check.

You might have guessed that my editorial wasn't going to go on at length about chocolate, though I wish that it could. I use the story to exemplify a reaction some hams have had to some very sobering news from England. In a letter to the April 6 issue of *The Lancet*, a very prestigious British medical journal, Dr. Samuel Milham, Jr., of Washington State reported on the results of a study of mortality among almost 1700 radio amateurs. That study, it seems, suggested that there might be more than a casual link between a radio amateur's exposure to higher than average radio-frequency fields and a higher incidence of certain types of leukemia.

In his letter, Dr. Milham points out that of the 1691 male members of the American Radio Relay League who died in Washington State and California between 1971 and 1983, 16 succumbed to myeloid leukemia. Statistics indicate that just 5.7 men should have contracted that illness. The figures for other types of leukemia also show increases above normal. In all, the radio amateurs experienced twice the incidence of leukemia as the general population.

According to Milham, studies reveal "a tendency toward a relative increase in the acute myelogenous type of leukemia in electrical workers" but he adds that "there is a strong association between employment in occupations with exposure to electromagnetic fields and membership in the American Radio Relay League." However the doctor states that "occupational exposure alone . . . .probably does not explain the leukemia excess in these men." In conclusion, Milham offers that his findings give "further support for the hypothesis that electromagnetic fields are carcinogenic."

Milham's findings are sobering stuff indeed but like other limited surveys might not tell the whole story. A response to his letter came from the ARRL. In the June 29 issue of *The Lancet*, the League's Committee on the Biological Effects of RF Energy responded to Dr. Milham with a letter of its own. Led by chairman Raymond B. Wangler, the ARRL committee disagreed "with Milham's conclusion that there is a causal link" between leukemia and amateur radio operations. They also took issue with his choice of radio amateurs to test the hypothesis.

The committee suggested that "the operating habits of amateurs are highly variable and often not very extensive." The members challenged the validity of Milham's statistical method and detailed several reasons why they felt the test group was not representative of hams in general. "The question is further complicated," the committee said, "by the possibility that toxic chemicals were commonly present in electrical/electronic equipment in days past." In conclusion, the ARRL group claimed that Milham's suggestion that electromagnetic fields might be carcinogenic remains purely speculative and offered that "it cannot be assumed that participation in amateur radio activities increases the risk of leukemia.'

Point and counterpoint . . . but the issue didn't end there. In July, a member of the Cancer Epidemiology and Clinical Trials Unit of the Radcliffe Infirmary (Oxford, England), Michel Coleman, penned a letter to *The Lancet* to chastise the ARRL committee for questioning Milham's statistical methodology. Coleman also criticized the committee for allegedly misrepresenting the doctor's suggestion that his findings lent support to claims that exposure to RF can be potentially carcinogenic. "It would be a pity," Coleman said, "if Wangler and colleagues' natural concern about declining membership of the amateur radio community in the United States . . . .led to their inappropriate criticism of epidemiological methods gaining currency."

Is there some lesson for radio amateurs in the debate played out in the pages of a British medical jour nal? I think so, but it is one that requires interpretation.

Like the idea that chocolate causes allergic reactions, the hypothesis that radio waves hurt us is too disruptive of our radio pleasures for some to give it any credence at all. For the prudent, Milham's findings wouldn't necessarily cause dust to gather on the 2-meter transmitter but it shouldn't give way to a cavalier approach towards RF exposure.

Since most amateur satellites operate at VHF and UHF and future birds will incorporate microwave transponders, it seems appropriate to consider personal safety when setting up a satellite ground station. Are all your rigs well shielded, especially high-power transmitters and amplifiers? Are connectors in good shape and can any RF energy radiate from your feedline? Also, is the antenna far enough away from people to reduce the near-field exposure to currently acceptable safe levels? (In a magazine article last year, an author suggested using a 435-MHz Mode B helical antenna in the same room as the operator . . . a very questionable practice.)

All the statistics aren't in and doctors might debate the effects of RF energy for many years. There may or may not be a cancer risk attendant to operating amateur radio equipment, but until we find out with some certainty, caution is a small price to pay.

Harold Winard, KB2M

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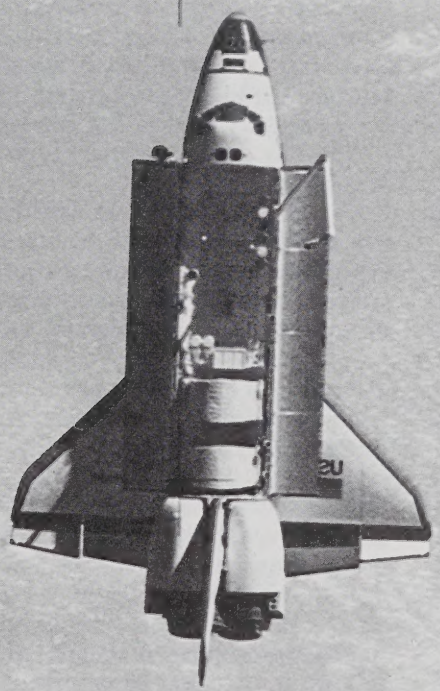

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Starting Out: A Beginner's Guide

By Andy MacAllister, WA5ZIB*

In an earlier issue I covered tracking options available to the amateur radio satellite enthusiast. At that time I did not have enough information to fully discuss the ultimate tracking system—the automatic computer rotor controller. Since then Spectrum West has introduced their Autotrak software and hardware packages for the Commodore 64, VIC 20, and Timex/Sinclair computers. I was involved in a small way with AMSAT's Sinclair interface project a few years ago and was very pleased to see that Spectrum West proprietor Jim Smith, KA7APJ, has taken the initiative to market a simple yet effective interface to automatically track satellites and position antennas using little more than an inexpensive home computer.

I ordered the interface for the Timex/Sinclair computer but due to production problems at Spectrum West I had to make do with a prototype until the final model was available. Autotrak requires 16 kbytes of RAM in the computer. In addition, the rotor control boxes must have meter-type readouts. Versions for other computers are very similar in operation, differing only in the type of card-edge connection and the software. When ordering it is important to specify the rotator type since different models have widely different output voltage ranges. The control interface must measure the output voltages in order to operate properly.

The software is simple, fast, close to real-time, and includes graphics capability. A map of the world is shown on the monitor or TV and depicts the desired satellite as a blinking pixel. The program is menu-driven and facilitates easy element-set updating and data output to a printer. Although the real-time control is accomplished using internal timing loops, it functions a lot better than anticipated. When the program gets behind, the user simply hits Return to increment the software-based clock.

Low-altitude satellites are updated every two minutes and high flyers, such as AMSAT-OSCAR-10, are done once every six minutes. My only complaint here is that the satellite orbital parameter set is nonstandard and typically requires information from more than one source. However, I found that data from the Project OSCAR calendar and the AMSAT nets provided all the necessary orbital information.

A combination of parts

The hardware connection from the computer to the rotor controls is ingenious. It consists of a power supply, two digital-to-analog converters, a dual operational amplifier, two dual comparators, triac-driver optocouplers, triacs, and an assortment of resistors, capacitors, LEDs, and signal diodes. The instructions could be a bit more graphic (pictorial examples, for example), especially on how to make the necessary connections. Nonetheless the instructions are well written and are quite good at guiding the builder through the wiring.

Most of the rotor connections are made to that device's control-box terminals. One extra connection requires digging into the rotor box and bringing a wire out to a spare lug. Calibration is easy though and involves the adjustment of four small potentiometers in order to define the end limits of the rotor.

LEDs indicate when the antennas are being moved by the computer and show Up, Down, Clockwise, and Counter-Clockwise directions. When the interface is off, the rotors can be used normally without any problems.

Tracking the birds

When I want to track OSCAR 10 or other satellites I simply turn on the computer, load the program, answer a few questions from the menu, and sit back. When the desired satellite shows up, the antennas start moving. I find myself cross-checking the data to other sources but typically I forget about the computer and antennas and just start operating. Since the program is in Basic, I had no problem inserting a few lines to add such niceties as returning the array back to its usual resting position when the satellite dips below the horizon.

As for reliability, I have just a few comments. The Timex/Sinclair computer has a notoriously poor expansion connector and I now have four items plugged into it. Since there are no earthquakes in my part of the country I have had few problems. Nevertheless, the installation is a bit sensitive to set up.

Recently a capacitor shorted on the interface board, turning a resistor into a small, momentarily brilliant light bulb. No other damage was done and after inspection of similar capacitors in the circuit I have written it off as a chance occurance. Quality components are the rule throughout the interface.

Overall, I am quite pleased with the Autotrak system. Programs and interfaces are in the works for several other computers. At $159.95, Autotrak is an affordable system for the inexpensive home computer. Spectrum West can be reached at 5717 NE 56th St., Seattle, WA 98105 or (206) 641-7461.

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What's Your Opinion?

Do you have an opinion on some aspect of the amateur-radio space program? Would you like to share it with other space enthusiasts? Send your opinions, typewritten and double-spaced, to Satellite Journal, P.O. Box 575, Wharton, NJ 07885. To give as many people a chance to have their thoughts put into print, please limit yours to one or two paragraphs.

Worldwide Satellite Operation

by Ray Soifer, W2RS*

Unlike those of you whose professional work involves electronics or computers, it isn't very often that my two worlds—investments and amateur radio—overlap. Recently however, I was surprised and pleased to find mention of PACSAT in a somewhat unusual setting, the annual report of J.P. Morgan & Co. Inc., parent company of the Morgan Guaranty Trust Company of New York. They, as do other large banks, value the roles played by many of their employees as volunteers in community service, and featured some of these in this year's report. Among those profiled was Paul K. Levengood, Morgan vice president and, for the past 15 years, a volunteer with the organization Volunteers in Technical Assistance, Inc. (VITA). Mr. Levengood, who as far as we know is not a radio amateur, noted that

"VITA plans to launch a low-level satellite which

will offer telecommunications networking in remote areas at a fraction of the cost of telexes. By 1987,

(VITA) hopes to download information almost anywhere in the third world as a major component of local

economic development. That's (VITA's) basic mission—to transfer appropriate technology where it's most needed . . . It's very simple. Direct. Just people helping people."

Another example of "people helping people" from whom we heard recently is Pierre Therrien, VE2AGC, of St-Eustache, Quebec. Paul, a new member of AMSAT, is president of Club VE2 International Inc. Responding to my invitation in my first column, Paul writes

"Je partage énormément la cause qui souhaite voir une meilleur comprehénsion entre tout les hommes pour une paix mondial durable. Habité par ce qui précède j'ai fondé un club qui se nomme Club VE2 International Inc. et qui propose comme philosophie de sensibiliser les hommes à ce besoin de communiquer pour un mellieur monde et ce en utilisant ce moyens extraordinaire mis à notre disposition la radio amateur.

"Encourager par le support d'organisme tel le Collège Lionel Groulx de Ste-Thérèse qui offre la possibilitée de diffuser des cours de formation pour l'obtention de la license d'amateur avec le matérial didactique nécessaire, le Club Optimiste St-Eustache Est respectant son idéal d'aide à la jeunesse mets à notre disposition une station satellite et qui sera la base d'une expérience enrichissante pour tout la communauté.

"Heureaux d'une telle implication dans l'entourage immédiat, je souhaite maintenant voir se développer dans le milieu radio amateur une effervescence qui se traduira par un vaste réseau de communications philantropique."

("I greatly share in the cause which wishes to see a better understanding among all peoples for a durable world peace. Therefore, I have founded a club called Club VE2 International Inc. which proposes as its philosophy to make people aware of the need to communicate for a better world and to use the extraordinary means available to us as radio amateurs.

"Encouraged by the support of such organizations as the Lionel Groulx College of St. Therese, which offers the possibility of disseminating correspondence courses for obtaining an amateur license along with the necessary teaching materials, the Optimists Club of St. Eustache East, respecting our ideal of aiding youth, is putting a satellite station at our disposal that will be the basis of an enriching experience for the entire community.

"Happy at such a response in our circle of friends, I hope now to see enthusiasm develop in the amateur radio community that will translate itself into a vast philanthropic network.")

By now, VE2AGC should have been heard on AMSAT-OSCAR-10. He may be contacted at 110, 32e Avenue, St-Eustache, Quebec J7P 3W7, Canada.

Another worker for "un paix mondial durable" is, of course, our own Pat Gowen, G3IOR. Pat's most recent letter notes that after the end of July, AO-10 began to encounter seasonal problems with the sun angle, culminating in severe eclipses of the sun as seen by the satellite's solar panels from August 4 to September 1. That resulted in reduced transponder on time, which coincided with poor orientation of the satellite's antennas toward the earth. Pat also bemoans the continuing tendency of some stations in western Europe and North America to use far too much power. That, of course, results in all signals being attenuated by the satellite's automatic gain control (AGC), as well as by normal power-sharing. AGC attenuation of 22 dB is becoming quite common, particularly on weekends. This senseless use of high power by a few makes it extremely difficult for many others to gain access to the satellite. In Pat's words,

"If some of these alligators, taking the power of one hundred or more logically powered stations, could be persuaded to QRP or QRT, then it would be quite apparent to those who consider the actual number of users to be low that in fact the employment in terms of users rather than power is quite high."

The irony of this situation is particularly applicable to those interested in working rare DX. What, one may ask, is the point of encouraging nationals of Third World countries—many of whom are not so affluent as other users—to build satellite stations when the use of high power by callers results in so much attenuation that the DX station is unable to access the satellite? Pat and I remind everyone not to use more than 500 W EiRP—10 W to an antenna with 17 dBi forward gain, or 50 W and 10 dBi—on AO-10 Mode B, and not more than 100 W EiRP—10 W and 10 dBi—on the Mode A RS satellites. No excuses, please. This means you!

We were also pleased to hear from Hans Eckert, SM3HBQ, of Hofors, Sweden. Has has been active on the satellites since 1980, and has served for the past three years as the financial manager of AMSAT-SM. (I served in a similar capacity with

(continued on page 11)

The Digital Front

by Harold Price, NK6K*

The male/female aspects of digital interactions

I am please to report that AMSAT is alive and well in Dallas. During a recent trip to the Dallas HAMCON, I observed that the donations received in the form of memberships, software, and "trinket" sales were quite good. In fact, the ratio of money to attendance was even better than that of this year's Dayton Hamvention.

The AMSAT group in Dallas always puts on a good show. This year the prime movers were the two assistant area coordinators for North Texas, Keith Pugh, W5IU, and Rusty Reeve, KT5U. The Dallas convention itself is well organized and has many of the major amateur manufacturers in the exhibitors area. They attract well-known faces for their programs as well.

That's the good news. The not-so-good news is that I heard a common misconception passed around one more time. While AMSAT membership is an invaluable aid to using the satellites, and AMSAT members have always played a major roll in the design, construction, and support of the OSCAR series, your AMSAT membership does not "pay" for the satellites.

Some time ago, I took a stab at working out a per-minute "rate" for AMSAT OSCAR-10 access time, i.e., what you would have to pay if that satellite was owned by a commercial concern. I figured the cost without including a profit, the rate is set only to recover the cost of OSCAR-10. I haven't seen much change since my original estimates were published in Amateur Satellite Report (ASR) No. 86, so here they are again. If you disagree, or even if you agree, send your comments in!

First, some assumptions. We would all like to get five good years out of AO-10. In round numbers, also assume we get 20 hours of communication each day. That gives 36,500 hours of communication for the expected life of the spacecraft.

There are about 150 kHz available for communications without counting Mode L. Ignoring the complications of CW (less bandwidth but slower data rate), there is room for 30 voice channels, each 5 kHz wide. That gives 1.95 million channel hours to use as a base to establish a "charge rate" to recover the costs of installation. Various sources have placed the cost of installation—construction and launch—at $240,000. To recover that cost, each AO-10 user should be charged $0.21/hour. That is a real steal. Compare that to the rates charged by Ma Bell and her kids

To review, 5 years MU 365 days/year × 20 hours/day × 30 channels = 1,095,000 channel hours. Then $240,000/1,095,000 channel hours = $0.021/channel hour. Thus, an OSCAR-10 user who spends 4 hours each week on the bird would rack up a bill of $43.00 each year. That is just to recover the cost, and does not include on-going maintenance (ground control costs), nor does it include design and implementation costs for a replacement. Note that this cost work-up assumes 100percent use. As we all know, we don't use 30 channels for 20 hours each day. A better estimate would be 10 channels. Just as in the real world, the less you use of a fixed cost utility, the more you have to pay for each use. Without going through all the calculations again, one third the use means three times the charge if we want to cover the complete cost of AO-10. Our 4 hour/week user is now paying $129.00 each year. A heavy user would pay more, especially those who are always louder than the beacon.

As you can see, even if all of your $24 yearly dues went to the spacecraft fund, it wouldn't approach the actual cost. Of course, not all of the dues go into a spacecraft fund, much of it goes into membership services, such as sending out renewal notices, advertising in various places, and other administrative and educational costs. It also pays for this magazine. Obviously, we can't charge for the use of OSCAR 10. Just as obviously, we can't launch another one based on the support we're getting for this one.

Why do I bring up this subject in the Digital Front column? Because without continued support for the amateur satellite program, there won't be any digital front in space, that's why.

The news is not all grim, however. Interest in the digital aspects of amateur radio is on a sharp upward curve, and a flatting of that curve, or even a flattening of its first derivative is nowhere in sight. While the attendance at the AMSAT forum in Dallas was high, the attendance at the packet radio forum was even higher, with close to 150 at each of two sessions. During the second session, attendees were subjected to 15 minutes of OSCAR 10 discussion, and 30 minutes of PACSAT talks. I'm please to report that no ill effects were evident, and no one ran from the room screaming. It continues to appear as if digital and satellite enthusiasts make a good mix. As shown by the above cost equations, we need more user/supporters. Expect many of them to come from the digital amateur ranks, and from just plain computer users who don't even know they want to be hams yet.

I've been asked several times lately about the level of packet activity on OSCAR 10. There are a reasonable number of people who have used packet on that satellite at least once, more than twenty and less than 50. This number is under the "critical mass" and a sustained reaction has never taken hold. Allow me to explain.

The phenomena of critical mass has been shown over and over in many different cities during the first stage of growth in packet radio. Activity would start in various places as individuals would build equip-

ment on their own, or would acquire a bare board VADCG terminal node controller (TNC). Packet radio users in the early 1980s had to struggle since the best "kit" at the time was a bare board, a parts list, and a schematic. While there were some true believers in each area who could overcome this hurdle (mainly a matter of inertia and the mutual attraction between posterior and reclining chair), the number was seldom enough to guarantee that someone else would be on the air to talk to. Those who were interested in using the mode would soon fall out of the habit of checking to see if someone was on, and the experimenter/builder types never use anything on the air after the first try anyway. They tear it apart for the next improvement. After an initial burst of action, activity would fall to background levels.

It took the development of a second generation of hardware and software to allow users to spend more time with their brains and less time with a soldering iron and shopping list. At that time activity levels grew high enough so that new participants could find someone to talk to once they got on the air. The same thing happened to packet use on AO-10. After an initial burst of activity, use died off. In 1984, many users were on each Sunday at apogee. At the time, the attitude of OSCAR 10 made apogee the best part of the orbit for communications. When orbital mechanics took apogee into the wee hours of the morning, activity dropped off, and never picked up again.

Many amateurs can and have used packet on OSCAR 10 and many more would like to give it a try. All we need is critical mass. Hint: There is one known way to reduce the number of warm bodies required to reach critical mass. An automatic system, such as a mailbox or gateway, drops the critical level from the 15-to-20 range down to the 5-to-7 level. What we need is someone who wants his name in the books as the catalyst that started the re-birth of packet on OSCAR 10 to make it his business to have his station on the air every day, and to supply a mailbox or gateway facility so there is "something" to talk to, even if there is not "someone" around. Hopefully someone will already have done that by the time this column sees print. If not, the next article will contain further browbeating on the subject.

Magic reaction

There is something magic about writing a column. Between turning it in and seeing it in print, things that are written about come to pass. For example, I wrote about software. Surprise! . . . Roy Welch, WØ SL, and Bob McGwier, N4HY, release new software in Dayton. I write about PSK demodulators for OSCAR 10 and then see an article in Ham Radio the next week (the April issue, by the way). I'd like to take credit for this, but since nobody had read the articles due to publication delay it must just be positive thinking. I hope the streak holds for the OSCAR 10 BBS. And by the way, sorry about the title. Somebody told me once that sex sells and I wanted to give it a try.

** 1211 Ford Ave., Redondo Beach, CA 90278*

de K2UBC

by Martin R. Davidoff, K2UBC*

The second Ham-in-Space mission, Shuttle 51-F, has come and gone and it seems likely that we will be seeing an increasing amount of such activity in the coming years. A mission with two German radio amateurs is currently planned for a November flight. Therefore selecting a ground station antenna that is suitable for these low-altitude missions seems like a good topic to discuss this month.

Contrary to what you may believe, all low-altitude orbits are not created equal. From a ground-station point of view there are significant differences between circular orbits at the shuttle height—about 250 km—and the more familiar RS-8 altitude, about 1700 km. For example, a ground station at 40 degrees north or south latitude will see about six RS-8 passes each day, three ascending and three descending. That totals roughly 90 minutes of access time. The central pass will generally last more than 20 minutes and remain at an elevation angle above 30 degrees for 10 to 12 minutes. The same ground station will have access to two shuttle passes at most, one ascending and one descending, for a total of about 15 minutes of access time. The total daily time during which the shuttle will be at elevation angles greater than 30 degrees will, in all likelihood, be less than one minute.

From a practical viewpoint, what do these numbers mean? There are several ways to answer that question. A casual ground station operator who has had excellent results through RS-8 using an omnidirectional (azimuth plane) turnstyle-reflector (TR) antenna that strongly favors high elevation angles will find that the antenna is very poorly suited for working the shuttle. Since the shuttle moves rapidly, and the line-of-sight distance is relatively low, an omnidirectional antenna is desireable but the TR-array is a poor choice. A simple ground plane—a 1/4- or 5/8-wave—will produce better results. With a little extra effort a Lindenblad antenna can be assembled that will feature an omnidirectional azimuth pattern, an elevation pattern similar to that of the 1/4-wave groundplane, and circular polarization. Since the astronauts aboard the shuttle will most probably be using linear polarization, a circularly polarized ground station antenna might significantly reduce fading.

Reduce fading might be especially important for video downlinks. The loss of a little information usually has a minor effect on the highly redundant content of an audio link but for a video link the same outage can have a severe impact.

When the station at one end of a link is using linear polarization, the choice of circular polarization sense—right-hand or left-hand—doesn't matter, so whichever is convenient can be used. (Incidently, I will provide a description of the Lindenblad antenna, reprinted from the Satellite Experimenter's Handbook, to anyone sending me a stamped, self-addressed envelope with one unit of postage.)

Using gain

If you feel that you must use a gain antenna then choose one with low gain. A 3-turn helix (circular polarization) should be fine. Keeping a high-gain beam accurately aimed at the shuttle is a tough challenge. However, if you have to make do with your high-gain OSCAR-10 antenna, you can usually simplify operation by dispensing with elevation tracking. On most passes just set the elevation at about 10 degrees and forget it. And don't forget that with a high-gain antenna it is critically important that you have very accurate tracking information.

For those of you interested in where the numbers quoted in the earlier material come from, I'll outline the methods used to obtain them. For a ground station at a latitude between 50 degrees south and 50 degrees north, and for satellites in low-altitude, near-polar circular orbits, the average daily access time is rougly porportional to the amount of the earth's surface in view of the satellite at any given time. From 250 km just under 2 percent of the earth's surface is visible. At 1700 km that figure increases to about 10 percent. (Although the shuttle orbit isn't quite polar, these figures still hold.)

To estimate the amount of time that a spacecraft will have an elevation angle above 30 degrees while it is in range, picture a spiderweb drawn around a ground station. The ratio of the terrestrial area inside the 30-degree elevation circle to the area inside the 0-degree elevation (acquisition) circle is the number we require. The Russian RS-8 spacecraft has an elevation angle greater than 30 degrees about 20 percent of the time. For the shuttle the number drops to about 5 percent. Both of these factors contribute to the rougly 20-to-1 difference in average daily access time above 30 degrees cited earlier when comparing RS-8 to the shuttle.

On some other topics . . . thanks go to Bent Bagger, OZ6BL, for sending me a copy of the W3IWI tracking program translated into Turbo Pascal for the IBM PC. The material has been forwarded to several amateurs working on enhanced versions of the W3IWI program using that language. Thanks also to Jim Miller, G3RUH, for sending an OSCAR-10 telemetry decoder PC board as described in *Ham Radio*, April 1985, pp. 50-62.

When I ran into John DuBois, W1HDX, (developer of the OSCAR-10 telemetry demodulator described in Orbit, Nos. 5 and 14) at a NOAA/NASA conference on weather and related satellites some weeks ago, Miller's demodulator naturally came up. We were both impressed by the design and workmanship. When I offered John the board in return for a promise to build it and report back on his experiences, he agreed. So, expect to see a report in the near future.

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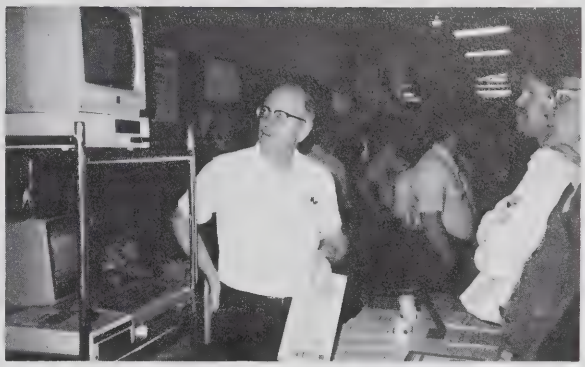
Comet

At the Dayton Hamvention, Roy Welch, WØSL, describes the operation of his satellite tracking program for interested visitors. The program, which features a world-map display of up to eight satellites, is available from the AMSAT Software Exchange.



Worldwide Satellite Operation
(continued from page 7)

AMSAT from 1972 to 1983.) Hans has just relinquished the financial post to become awards manager, and asks me to mention two certificates offered by AMSAT-SM to satellite users. One is based on the well-known WASM award and requires applicants to work and confirm one station in each of Sweden's eight call areas, SMØ through SM7. It is based on modes, e.g., Mode A, Mode J, Mode L, etc., rather than satellites; a separate award is available for each mode. To apply, send your eight QSL cards and 10 International Reply Coupons (IRCs) for return postage to SM3HBQ at Box 119, 81300 Hofors, Sweden.

In addition, a new award will be available by the time this appears in print. This will require two-way contacts via satellite with 25 members of AMSAT-SM, and receipt of their AMSAT-SM membership numbers, either on their QSL cards or over the air. It is not necessary to send the original cards to claim this award; photocopies of either the QSL cards or the logbook, verified by two licensed amateurs and accompanied by 10 IRCs, will be sufficient. There are 186 members of AMSAT-SM, most of whom are equipped for satellite operation, out of 8000 licensed Swedish amateurs. Would that all countries have that sort of representation!

A brief personal note: As I mentioned in *Satellite Journal* No. 1, I have been acting as interim columnist to help get the publication going. The heavy demands of my work and travel schedule now must, regrettably, take precedence. Therefore, this will be my last column. I hope to meet as many of you as possible over the air, and in person at AMSAT functions, in months to come. For now, 73.

**60 Waldron Ave.*
Glen Rock, NJ 07452 U.S.A.

W 6 Space Philosopher

by John Browning, W6SP, Chairman of the Board*

Since we represent a cross-section of world society, radio amateurs are a completely non-homogeneous group. We vary in our backgrounds, in our means, and in our inclinations. Our differences obviously extend to individual preferences for utilization of assigned frequencies. In particular, some of us like to develop new communication techniques and equipment while others prefer to exploit current technology through on-the-air operation. In spite of our segmentation, we manage to accommodate each other surprisingly well.

The amateurs who enjoy themselves most are those who retain the flexibility to wander back and forth through the different categories and modes. Since most people don't know if they like or dislike something until they try it, a certain amount of technical and procedural open-mindedness contributes to continued satisfaction with our favorite avocation.

I am completely unable to describe a typical "ham." The amateurs I know are clearly atypical. For instance, there is my friend Cleyon Yowell, AD6P. At heart, he is a Kansas farm boy who often dreams of meals served to threshers at wheat harvest time. Nonetheless, as a result of his having dedicated a few formative years to institutions like the Massachusetts Institute of Technology and the University of Southern California, Cleyon now functions professionally as an Aerospace Corporation scientist. As such, he is often addressed as "Doctor Yowell."

At the company amateur radio club, Cleyon is known as "Mister President." In that capacity, he recently orchestrated the installation of a complete OSCAR satellite station in the club's facility. So far, the new station has achieved one dramatic, two-way, AMSAT-OSCAR 10, contact over the 44,615-statute-mile path between the California communities of El Segundo and Rancho Palos Verdes.

Cleyon's other amateur contributions are even more impressive. He generously purchased and installed a 2-meter repeater for the Southern California DX Club. From the top of 5000-ft Mount Lukens, the repeater regularly provides wide-area FM coverage on 144.88/145.48 MHz, while appropriately identifying as AD6P/RPT. Many AMSAT members got to meet Cleyon last fall when he served with distinction as chairman of AMSAT's second annual technical symposium. As a confirmed California commuter, he systematically researches the high-frequency propagation characteristics of various sites during his twice-daily parking sessions on Los Angeles-area freeways. Between mobile radio contacts, Cleyon amuses himself by reading bumper stickers on cars ahead. When he spots one which asks the question, "Are we having fun yet?," he knows the answer is "Yes!"

Most amateurs are less adaptable than Cleyon. That situation provides a great challenge for AMSAT officials. To respond to conflicting membership requirements, frequent compromises are mandatory. The trick is to adopt a balanced policy that is both reasonable and acceptable to all. In that case, "all" must include consideration of potential future members if they are to be enticed to "join up."

On most issues considered by AMSAT's board of directors, we readily arrive at a consensus for appropriate action. One exceptional area involves competitive operations. We have been very cautious about promoting activities that might increase the use of potentially destructive high uplink power. We were encouraged with the restraint exhibited by most participants in the recent Northern California DX Foundation sponsored Stoner Challenge Cup competition. At our annual meeting in November 1984, the Board voted, by a slim majority, to recommend, to the American Radio Relay League, an expansion of the non-endorsable satellite DX Century Club award to include contacts through AMSAT-OSCAR 10.

Conventional wisdom holds that, to endure, an enterprise must strive for growth. Most of our current members agree. In fact, many are quite uncomfortable with the lack of interference on the AMSAT-OSCAR-10 passbands. They want to overcome that deficiency. Amateur bands are supposed to be crowded!

The communicators among us seem well aware of the absolutely essential need to accommodate volunteers with spacecraft engineering

and manufacturing talents. Anybody can see we are nothing without a pipeline supplying and orbiting new satellites. To induce them to make the accompanying personal sacrifices, the capable volunteer builders must be afforded challenges in the form of new development opportunities. They must also retain considerable flexibility and reasonable independence from traditional bureaucratic constraints. Nevertheless, they have been conditioned to accept the strict disciplines imposed by the realities of launch schedules and funding limitations.

On the other hand, the engineers have some doubts about their need for formal affiliation with the users. They correctly observe they have among their ranks individuals who have been the principal arrangers of launch opportunities. They have successful fund raisers as well. With a small, streamlined group, they might be able to accomplish many of the objectives of the amateur satellite program themselves, with greater efficiency and less complexity.

Those of us, who enjoy meandering among all aspects of amateur radio, hold a strong opinion regarding the proper direction for our future thrust. We believe progress will be enhanced by continued promotion of a strong, dynamic, and growing membership composed of dedicated amateurs with a variety of interests and talents. Through continued application of good operating discipline and adequate financial support, the users may be able to convince the satellite builders of the desirability of maintaining close ties between factions. By cooperating, we are most likely to ensure continuation of both technological progress and operating pleasure. We can best justify our use of precious frequencies with an integrated organization that provides both close liaison and checks and balances between builders and users. The essential common thread is an ability to experience personal enjoyment and satisfaction while usefully contributing to the advancement of space communications.

Are we having fun, yet?

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Satellite Journal is the very best way for AMSAT to keep its readers informed about the latest developments in the radio amateur space program. It's a vital link to the satellite user that relies on the goodwill of its advertisers.

When you call or write one of those manufacturers or retailers, tell them you saw their advertisement in *Satellite Journal*. You'll help demonstrate the importance of the satellite community and also ensure our continued growth and service to the membership.

AMSAT NEWS

Tom Larson, N1CHM, To Manage AMSAT Video Library

Tom Larson, N1CHM, of Dover, Massachusetts, will be picking up responsibility for the AMSAT Video Tape Library. He takes over for Roger Johnson, WB0GAI, who stepped down from the post in August to take on new professional responsibilities in connection with his medical practice.

Tom owns an audio-visual production company in Boston. He plans to issue a mailing address and procedures for borrowing tapes from the library in the near future.

Colorado Group to Host Annual Meeting, Space Symposium

Colorado will be the host of the 1985 AMSAT Annual Meeting and Third Annual Space Symposium. The meetings have been scheduled for the Vail area with The Space Symposium and Annual Meeting on Saturday, November 9. The Autumn Board of Directors meeting will be held in the same vicinity on Sunday, November 10.

Molly Hardman, N3CHZ, has been named general chairperson of the project committee. She will be naming other managers to handle programs, prizes, accommodations, transportation, and other details of the meeting. Upwards of 200 are expected to attend this year's meeting.

A call for papers has been issued in connection with the space symposium. Interested authors should send a letter of intent to Molly Hardman, N3CHZ, 3994 Promontory Court, Boulder, CO 80301. Announcements will be made regarding hotel accommodations and group airline discounts as arrangements are are firmed.

Director Nominees Number Eight

AMSAT has announced nominees for the position of member of the board of directors. The nominees are:

John Browning W6SP* Rancho Palos Verdes, CA
Gordon Hardman KE3D Boulder, CO
Jan King W3GEY* Boulder, CO
Julian Macassey N6ARE Pasadena, CA
Andy MacAllister WA5ZIB Pearland, TX
Harold Price NK6K Redondo Beach, CA
Paul Roemer KG6LC/1 Manchester, NH
John Henry VE2VQ Vanier, ONT
*Incumbents

John Pronko, W6XN, has opted not to run for reelection. Election ballots will be mailed from AMSAT headquarters to all current members.

Assistant Area Coordinators Named

Several new assistant area coordinators have been named, including Bob Myers, KB4AKQ, South Carolina; Hank Fitz, WB4URU, Florida; and Millard Croll, K3PTQ, Pennsylvania. Ohio assistant coordinator Eric Rosenberg, WA6YBT, has moved to Harrisburg, PA, and has been re-assigned in the same capacity for Pennsylvania.

A Spacewear Patch

John Champa, K8OCL, is wondering aloud if anyone is interested in Shuttle 51F mission patches. John says they could be made available for $5.00 a crack. Let him know your interest please. An SASE always helps. Write to John Champa, K8OCL, 7800 Hartwell St., Dearborn, MI 48126.

Callsign Monitoring

Ed Steeb, WA2RDE, of Buffalo, NY will be heading up a new project to keep track of callsign prefixes that appear on AMSAT-OSCAR-10. The list will provide a fair reckoning of how many countries are on or have been on the satellite.

On a related note, Don Knollinger, WB8ZTV, will soon be heading up a Gateway project team. He will organize gateway activities and promote interesting and useful events through them.

AMSAT Receives Donation

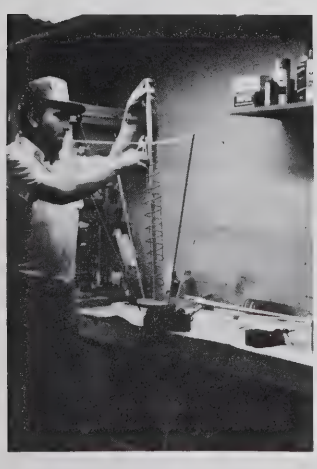
The Central States VHF Society has presented AMSAT with a $400 donation to symbolize its enthusiastic support of the amateur space program. CSVHFS president Charlie Calhoun, WØRRY, presented the check to AMSAT president Vern Riportella, WA2LQQ, at the society's conference banquet in Tulsa this summer.

Helicone antenna offers Mode L design alternative

A little known antenna design gives some surprising test results in a tale of "Whoa! At Home on the Range"

by Vern Riportella, WA2LQQ† and Art Emerson, N2BKT*

Common sense seems to say that the combination of a helix and a conical horn should yield an antenna with superior performance. Such an antenna simply looks as if it should work. In fact it was just such a notion that developed after seeing a picture of a helicone built by Dr. Viktor Kudielka, OE1VKW (cover of *Orbit* magazine No. 19, Nov./Dec. 1984). Some additional incentive to build the antenna was provided by Jerry Elder, KAØOOQ, who sent us an extract of a published letter by K.R. Carver describing the helicone. That letter, "The helicone—a circularly polarized antenna with low sidelobe level," appeared in a publication of the Institute of Electrical and Electronic Engineers (IEEE).[1]



Art, N2BKT, assembles the helicone antenna from an assortment of wooden dowels, wire, and a liberal amount of hot glue.

The source antenna is a simple half-wave dipole mounted one half-wavelength over a one-wavelength square screen. It was fed with 200 mW at 1269 MHz.

The letter suggested very substantial gain improvements in the combination of a helix and a conical horn. Carver stated that "the gain of the [helicone] is four times that of a simple helix of the same length, and the sidelobes are 15 to 20 dB lower." To most folks who read that, it sounded like a formula for a quick 6-dB power gain. Right? Well maybe.

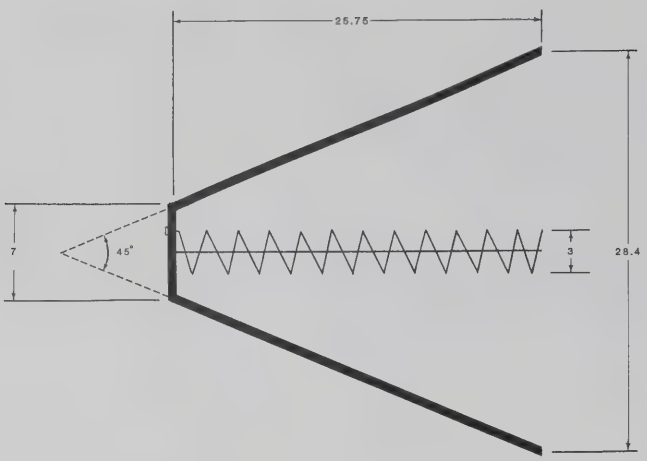
Describing the helicone, Carver wrote "an approximate expression for the directivity D of the helicone has been found empirically, for mouth diameters between 2 and 4 wavelengths, to be: $D = 7.8\ d^2$, where d is the mouth diameter in wavelengths." Using Carver's formula it's easy to figure the potential gain. For example, if the mouth diameter is 3.05 wavelengths (28.4 in. at 1269 MHz), the directivity is 72.6 and the power gain is 18.6 dB (power gain = 10 log D). Although at lower frequencies the helicone becomes unwieldy, at about 1 GHz the dimensions become attractive. Of course at yet higher frequencies parabolic dish antennas excel.But at at the AMSAT-OSCAR-10 Mode L uplink frequency of 1269 MHz, the helicone appeared to have a number of very nice features.

Testing the dream

With visions of power gain dancing in our heads as so many Lipizzaner stallions, we set our imaginary horses at full gallop. "Think of it! Row upon row of helicones!" Fortunately we made one minor concession to practicality and caution by building and testing just one helicone before setting off on a mass production effort. The antenna was a simple 24-cm helicone and the test was a careful evaluation of gain performance on a homebrew antenna range. What we found on the range said "Whoa!" to our imaginary horses. Our results may give pause to others considering the helicone.

Based on the data provided in several well-know references, we constructed a 12-turn helix of standard design [2-4]. The pitch angle was 12.5 degrees and the circumference of each turn was one wavelength. The helix was constructed of No. 12 copper wire and had a reflector fashioned from a 7 in. (0.75 wavelength) screen[5] mounted on a plywood disk. The helix was then enclosed in a conical horn with dimensions similar to those described by Carver (Fig. 1). The cone was fabricated of yellow brass window screen, a material chosen mainly because it was solderable and readily available. The horn apex angle was 45 degrees and the height equalled the helix boom length.

Construction was relatively easy and relied on wooden dowels, copper wire, and copious amounts of hot-melt glue to hold the structure together. Since it was merely a test antenna, no provisions were made for durability; hot-melt glue seemed completely ap-



1. The basic helicone design uses a conventional helix antenna surrounded by a conical horn. The dimensions shown, for a 24-cm antenna, are in inches.

propriate for our purpose.

The input impedance of the helicone was matched to a 50-ohm line using the standard trick of deforming the first turn—the one closest to the reflector—so that it was located closer to the screen.[5] The antenna was then tuned for minimum VSWR, about 1.3:1.

To test the helicone for gain, a standard-gain antenna was constructed in accordance with the Electronic Industries Association Standard RS-329-A (Dec. 1975). The standard-gain antenna was scaled for 1269 MHz using data for antennas at 406 to 450 MHz.[6,7] The gain of the antenna at the design frequency is between 7.5 and 8.0 dBd. However, when the homebrew standard-gain antenna was subsequently checked against the Model H5001 standard-gain horn from American Electronic Laboratories (Lansdale, PA), it evinced some problems. The homebrew antenna showed about 5.2-dBd gain on a homebrew antenna range instead of the expected 7.5 to 8.0 dBd. Scaling constants errors are suspected as the source of the significant error. Thus the homebrew RS-329 test antenna was shelved in favor of the standard-gain horn.

Ranging far afield

The antenna test range was set up at WA2LQQ and proved an excellent facility, free from the usual problems caused by reflections from power lines, vehicles, and other major structures, trees for example. One of the benefits of building such a facility on a former cornfield is the absence of trees. Yes, it was truly home on the range.

The antenna test range was similar in concept to the National Bureau of Standards (NBS) 45-degree slant test range but with some modifications. [8] For example, the illumination source antenna was positioned at the 24-ft level of a 30-ft tower and the antenna-under-test was located near the ground for convenience (Fig. 2) On the standard test range the antenna being tested is on the tower.

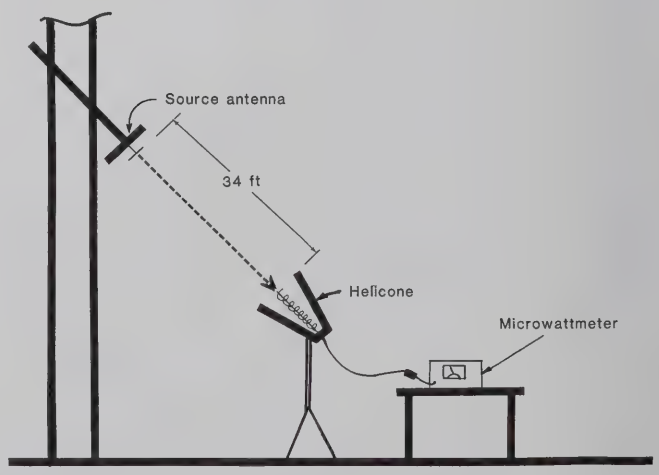
A slant range is used to reduce ground reflections. The path length for the test was about 34 feet (45 wavelengths) with a 45-degree slant angle. The anticipated test-antenna gain was about 18 dBi. For an antenna of circular aperture and that gain, the minimum range path is about 10 feet [9].

The source antenna was a simple half-wave dipole positioned one half wave over a one-wavelength square ground screen. The antenna was fed with about 200 mW. Received power was measured on a well-calibrated Boonton Model 42A microwattmeter and was of the order of 1 to 10 microwatts. Ambient RF flux was at least − 40 dB from those levels.

The empirical data cited in the Carver paper suggests that our helicone should have had a gain of 18.6 dBi based on its dimensions. Although Carver did not explicitly say, it is presumed that the 18.6-dBi figure refers to a circularly polarized isotropic source, often denoted in dBic. But in fact, the helicone exhibited 0.5 dB less gain than our standard-gain horn reference antenna. Since the linearly polarized standard-gain horn is well-characterized, and at 1.27 GHz has 13.1 dBi gain, the helicone must have 0.5 dB less, or 12.6 dBi.

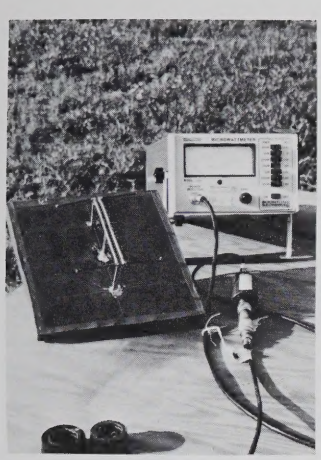
Next, the helicone gain was converted from a linearly polarized isotropic reference to circular polarization, that is dBic. To do that, it was necessary to determine the axial ratio of the helicone. [10] For a helix it was assumed that the axial ratio would be zero. Using the usual rule-of-thumb, it seemed correct to merely add 3 dB to convert from dBi to dBic. How wrong we were!

The axial ratio of the helicone was measured by rotating the source antenna around an axis representing a line between the source antenna and the helicone. To our dismay the axial ratio turned out to be a dismal 4 dB. At worst, a 1- or 2-dB axial ratio was expected. That was not our idea of a helix antenna and its heralded circularity! Yet there was nothing in its appearance which would signal the cause of the high axial ratio. The helix was circular and lay perfectly centered in the cone. The observed axial ratio performance remains a mystery.



2. A homebrew antenna test range has a 45-deg. slant. For convenience, the test antenna is located on the ground and the source antenna is mounted on a nearby tower.

If the axial ratio is 0 dB, then the well-known 3-dB



The homebrew 24-cm standard-gain antenna sits alongside the microwattmeter used for the tests.

Art carefully aims the test helicone towards the source antenna.

conversion rule-of-thumb holds. However, when the axial ratio is not zero, the conversion is more complex. A handy nomograph makes this conversion easy. [11] With a 4-dB axial ratio, the correction factor is 1.25 dB. Adding that figure to the test value of 12.6 dBi, yields 13.8 dBic. That is obviously a far cry from the 18.6 dBi predicted by Carver. On the other hand, that value compares favorably with the real-world values of a plain-vanilla 12-turn helix. [12]

Further research will focus on the difference between the gain predicted by Carver and the helicone gain measured at WA2LQQ. However, based on some initial analysis, a working hypothesis has been established that will form the basis for future tests.

Disappointing results

The helicone plainly did not live up to expectations but there is some information to help determine why the gain fell short by 4.8 dB. Firstly, gain and directivity are aspects of the same phenomena—focusing energy in a preferred direction to the detriment of other directions. In general, for helices and Yagis, the longer the boom, the higher the gain. Now this is tantamount to saying that when the gain is high, the total misdirected energy is low. Thus if a long helix already has most of its energy headed in the preferred direction, there is little left for the cone to do but round up the occasional minor lobe and redirect it. In other words, when a helicone starts off with a long helix, there may be so little energy remaining in the sidelobes that the advantage of a helicone over an ordinary helix diminishes to the vanishing point.

Conversely, for a relatively short helix, say 4 or 5 turns, it is likely the conical horn will have a dramatic effect in improving the directivity and increasing the gain. Taken in this light, the long helix may have been at the high end of the scale in a regime of diminishing returns. In this regime, perhaps, very little gain improvement can be be realized by adding a conical horn to the basic helix. Further study may find notable gain improvements in short helices placed in conical horns compared to ordinary short axial-mode helices.

Some benefits after all

Despite its disappointing performance, constructing the helicone was a rewarding exercise. For one thing it made us think more seriously about how unwieldy a 70-cm helicone would be since the cone would be over seven feet across at the mouth! But for 24-cm, the helicone makes an interesting weekend project that is tolerant of substantial errors in dimensions. Unlike a 1269-MHz Yagi, which requires superb tolerances to operate properly, the helicone is inherently broadbanded and works reasonably well in spite of loose tolerances. The forgiving nature of helices exacerbated our bewilderment at having missed the anticipated gain value by so much!

But even if we HAD attained the 18.6-dB predicted gain, compared to a state-of-the-art long loop Yagi, the helicone seems a bit of a bother. A well-designed loop Yagi can approach 20 dBi (albeit linearly polarized) and has far less wind area than the helicone. And although Carver claims that one of the main benefits of the helicone is its very low sidelobes, that is usually less important to radio amateurs than forward gain. Thus if low sidelobes are important, as they are for radio astronomers, then the helicone offers some advantage. But if forward gain is the objective, there seem to be easier ways to attain it than the helicone, even if it is possible to obtain the claimed gain.

In sum, was the helicone worth all the bother? If it were all that good, it seems likely that it would have been fully exploited in the nearly two decades since it was described and it would not be an arcane relic in the amateur radio antenna-design closet. It has not been exploited. We may have learned why!

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2. Martin Davidoff, *The Satellite Experimenter's Handbook*, American Radio Relay League (ARRL), Newington, CT, (1984), pp. 6-16, 6-17.
3. ARRL, *The ARRL Antenna Book*, 14th ed., 1982, p. 12-9.
4. J.D. Kraus, *Antennas*, McGraw-Hill, New York, 1950, Chapter 7.
5. ARRL, ibid, p. 6-17 and Fig. 6-21.
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10. Kraus, ibid.
11. Paul J. Sroka, "Nomograph saves time in converting antenna gain," *MicroWaves*, March 1974, pp. 54-56.
12. Davidoff, p. 6-17, Table 6-8.

Orbital Elements

Satellite: rs-5

Catalog number:	12999	
Epoch time:	85192.66782482	
	Thu Jul 11 16:01:40.64	1985 UTC
Element set:	254	
Inclination:	82.9601	deg
RA of node:	291.6357	deg
Eccentricity:	0.0009847	
Arg of perigee:	24.5501	deg
Mean anomaly:	335.6025	deg
Mean motion:	12.05060697	rev/day
Decay rate:	4e-08	rev/day^2
Epoch	rev: 15685	
Semi major axis:	8033.807	km
Anom period:	119.496056	min
Apogee:	1667.209	km
Perigee:	1651.387	km
Ref perigee:	2748.67344867	
	Thu Jul 11 16:09:45.965	1985 UTC

Satellite: rs-7

Catalog number:	13001	
Epoch time:	85214.16832929	
	Fri Aug 2 04:02:23.650	1985 UTC
Element set:	210	
Inclination:	82.9598	deg
RA of node:	274.8115	deg
Eccentricity:	0.0020845	
Arg of perigee:	260.8587	deg
Mean anomaly:	99.0116	deg
Mean motion:	12.08694160	rev/day
Decay rate:	4e-08	rev/day^2
Epoch	rev: 15992	
Semi major axis:	8017.688	km
Anom period:	119.136838	min
Apogee:	1676.788	km
Perigee:	1643.362	km
Ref perigee:	2770.14557480	
	Fri Aug 2 03:29:37.662	1985 UTC

Satellite: rs-8

Catalog number:	12998	
Epoch time:	85218.15104683	
	Tue Aug 6 03:37:30.446	1985 UTC
Element set:	332	
Inclination:	82.9594	deg
RA of node:	280.6158	deg
Eccentricity:	0.0019674	
Arg of perigee:	28.3444	deg
Mean anomaly:	331.8735	deg
Mean motion:	12.02955270	rev/day
Decay rate:	3e-08	rev/day^2
Epoch rev:	15964	
Semi major axis:	8043.185	km
Anom period:	119.705199	min
Apogee:	1685.612	km
Perigee:	1653.964	km
Ref perigee:	2774.15754160	
	Tue Aug 6 03:46:51.594	1985 UTC

Via Phil Karn, KA9Q

Satellite: oscar-9

Catalog number:	12888	
Epoch time:	85220.47241322	
	Thu Aug 8 11:20:16.502	1985 UTC
Element set:	782	
Inclination:	97.6351	deg
RA of node:	X09.3591	deg
Eccentricity:	0.0004095	
Arg of perigee:	88.5793	deg
Mean anomaly:	271.5910	deg
Mean motion:	15.27489924	rev/day
Decay rate:	1.391e-05	rev/day^2
Epoch rev:	21321	
Semi major axis:	6858.421	km
Anom period:	94.272308	min
Apogee:	504.079	km
Perigee:	498.462	km
Ref perigee:	2776.48849061	
	Thu Aug 8 43:25.588	1985 UTC
Beacon:	145.8250	MHz

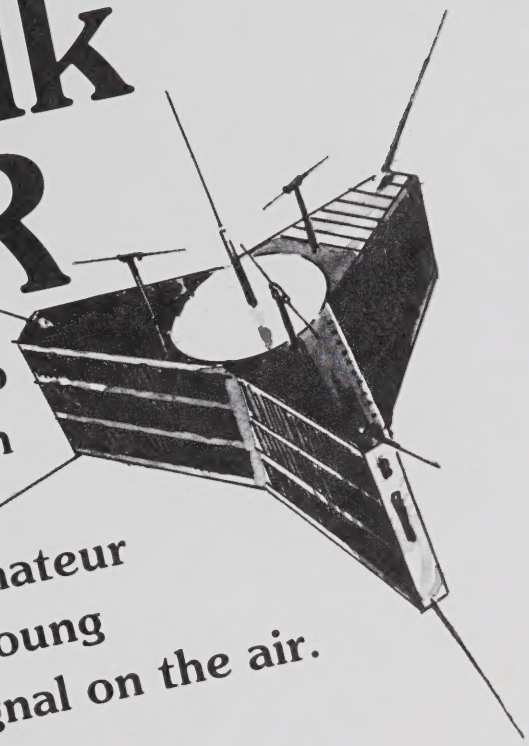
Satellite: oscar-10

Catalog number:	14129	
Epoch time:	85219.99375159	
	Wed Aug 7 23:51:00.137	1985 UTC
Element set:	193	
Inclination:	26.2768	deg
RA of node:	125.4745	deg
Eccentricity:	0.5967013	
Arg of perigee:	34.9434	deg
Mean anomaly:	352.5319	deg
Mean motion:	2.05857632	rev/day
Decay rate:	− 4.5e-07	rev/day^2
Epochrev:	1620	
Semi major axis:	26105.328	km
Anom period:	699.512564	min
Apogee:	35305.641	km
Perigee:	4151.475	km
Ref perigee:	2776.00382881	
	Thu Aug 8 00:05:30.809	1985 UTC
Translate freq:	581.0047	
MHz Invert:	1	
Beacon:	145.8100	MHz

Satellite: oscar-11

Catalog number:	14781	
Epoch time:	85206.24726934	
	Thu Jul 25 05:56:04.70	1985 UTC
Element set:	80	
Inclination:	98.1904	deg
RA of node:	272.0005	deg
Eccentricity:	0.0014497	
Arg of perigee:	103.8232	deg
Mean anomaly:	256.4583	deg
Mean motion:	14.61981488	rev/day
Decay rate:	7.6e-07	rev/day^2
Epoch	rev: 7459	
Semi major axis:	7061.998	km
Anom period:	98.496459	min
Apogee:	713.846	km
Perigee:	693.370	km
Ref perigee:	2762.26694235	
	Thu Jul 25 06:24:23.819	1985 UTC
Beacon:	145.8260	MHz

We talk OSCAR



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TR-9130

TR-9130 2 meter all mode

The TR-9130 is a compact rig that gives you 25 watts of RF power on all modes!! You can select your tuning steps from 100-Hz, 1-kHz, 5-kHz or 10-kHz. With six memories, you can program your favorite frequencies! (FM 1-5 Simplex or ±600-kHz offset, memory 6 non-standard offset, all six for simplex, any mode!) Dual digital VFO's, and transmit frequency tuning enhance OSCAR operations.

Internal battery back-up (9 V Ni-Cd not Kenwood supplied) retains memories for approximately 24 hours, in case you operate mobile and base!

Other convenient features such as automatic band scan, squelch circuit for FM/SSB/CW, tone switch, repeater reverse switch, CW semi break-in; sidetone, high performance noise blanker HI (25) LOW (5) power switch (FM/CW) RF gain control, and RIT circuit further enhance this expressive package!

Optional accessories:

- KPS-7A AC power supply.
- PS-20 AC power supply (TR-9500 only).
- BO-9A system base with memory back-up supply.
- SP-120 external speaker.
- TK-1 AC adapter for memory back-up.
- SP-40 mobile speaker.
- SP-50 mobile speaker.
- SW-100 A/B power meters.
- MC-55 Mobile Mic w/time-out timer.

TR-9500

70 CM SSB/CW/FM transceiver

- Covers 430-440 MHz, in steps of 100-Hz, 1-kHz, 5-kHz, 25-kHz or 1-MHz.
- CW-FM Hi—10 W, Low—1 W. SSB 10 W.
- Automatic band/memory scan. Search of selected 10-kHz segments on SSB/CW.
- 6 memory channels.

TS-711A/TS-811A

Multi-function all-mode 2 m and 70 cm transceivers.

The TS-711A 2 m (142-149 MHz) and TS-811A 70 cm (430-450 MHz) all-mode transceivers are perfect base station units, designed to complement your present HF station. Both feature Kenwood's innovative D.C.S. circuitry. Built-in dual digital VFO's provide commercial-grade frequency stability through the use of a TCXO (Temperature Compensated Crystal Oscillator). The new fluorescent multi-function display shows frequency, RIT shift, VFO A/B, SPLIT, ALERT, repeater offset, digital code, call sign code, and memory channel. 40 multi-function memories store frequency, mode, repeater offset and tone. They have programmable scan, memory scan, and mode scan. The Auto-mode function automatically selects the correct mode for the frequency being used. When a mode key is depressed, an audible "beeper" announces mode identification in International Morse Code.

The TS-711A/TS-811A also feature all-mode squelch, noise blanker, speech processor (SSB, FM), IF shift, RF power control, alert, and a unique channel Quick-Step tuning that varies tuning characteristics from conventional VFO feel, to stepping action when CH.Q switch is depressed.

Combine all these features with built-in AC power supply and a hefty 25 watts RF output power and you have your ideal base station.

Optional accessories:

- CD-10 Call sign Display
- TU-5 CTCSS Tone Unit • VS-1 Voice Synthesizer • MC-60A Deluxe Desk Mic • MC-80 Desk Mic • MC-85 Desk Mic
- SP-430 External Speakers
- MB-430 Mobile Mount
- PG-2J DC Cable